

## CHAPTER 2

### CORNEA TRANSPLANTATION

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## 2.0 INTRODUCTION

Cornea transplantation surgery allows restoration of vision in patients with corneal blindness. Cornea transplantation in Malaysia dates back to the 1970's. Today it is widely performed by ophthalmologists throughout the country both in the government and private sectors with each centre maintaining its own data.

The National Transplant Registry (NTR) was established in December 2003. The cornea transplant section of the NTR was given the task of establishing a systematic centralised data collection centre for all cornea transplantation performed in the country.

A total of 46 centres registered and agreed to provide information on retrospective and prospective cornea transplant activities. A total of 46 contributing surgeons participated in the NTR – Cornea Transplant section. Participation was voluntary.

**Retrospective data** (from 1998 to 2003) on cornea transplant activities were collected to identify the trend of cornea transplant surgery in the past few years. Retrospective data collected was recorded on the **Retrospective Cornea Transplant Notification Form (Form R-mds)**. This was limited to *minimal data set* which were i) demographic data, ii) type of cornea transplant surgery and iii) primary diagnosis for cornea transplantation. All surgeons agreed to provide all information required in the Retrospective Cornea Transplant Notification Form.

**Prospective data** (from the year 2004) on cornea transplant activities involved gathering information on all cornea transplants performed in Malaysia on two forms. The first form was the i) **Cornea Transplant Notification Form (Form N-cds)** which is completed at the time of surgery and gathers information on the recipient, operative procedure and the donor. Most surgeons sent a complete data set from 2004 as required in the prospective Cornea Transplant Notification Form. Some surgeons chose to provide only minimal data set as per Retrospective Cornea Transplant Notification Form (Form R-mds). The second form was the ii) **Cornea Transplant Outcome Form (Form O-cds)** which is completed at the end of 12 months and annually thereafter. Follow-up only ceases upon failure of graft, death or loss to follow-up of the patient. Most surgeons sent a complete data set from 2004 as required in the prospective Cornea Transplant Outcome Forms. Some surgeons chose to provide only minimal data set as in the Cornea Transplant Outcome minimal data set Form (Form O-mds).

The Cornea section of the NTR will be discussed under 3 sections.

*Section 2.1* and *Section 2.2* covers notification data on cornea transplantation over 9 years from 1998 to 2005. Effort was made to ensure that all cases of cornea transplantation were reported. To the best of our knowledge, this report provides information on all cornea transplants performed in the country.

*Section 2.3* covers prospective notification data on cornea transplantation (*from 2004 onwards*) from surgeons who sent a complete data set.

\* Outcome data will be presented in next years' report.

## 2.1 CORNEA TRANSPLANT ACTIVITIES AND TRENDS (1998-2006)

The number of cornea transplants performed showed an increasing trend from 119 in 1998 to 221 in 2001, following which there was a slight decline in 2003 followed by a progressive increase each year to 192 in 2005 but this declined to 174 in 2006 (Table 2.1.1).

Penetrating keratoplasty was the most frequent type of cornea transplant surgery and was performed in 93% of cases (Table 2.1.2).

Table 2.1.1: Number of Cornea Transplantation and Transplant Rate per million population (pmp), 1998-2006

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. of new transplants	119	122	126	221	203	165	184	192	174
New transplant rate pmp	5	5	5	9	8	7	7	7	7

Figure 2.1.1: New Transplant Rate, 1998-2006

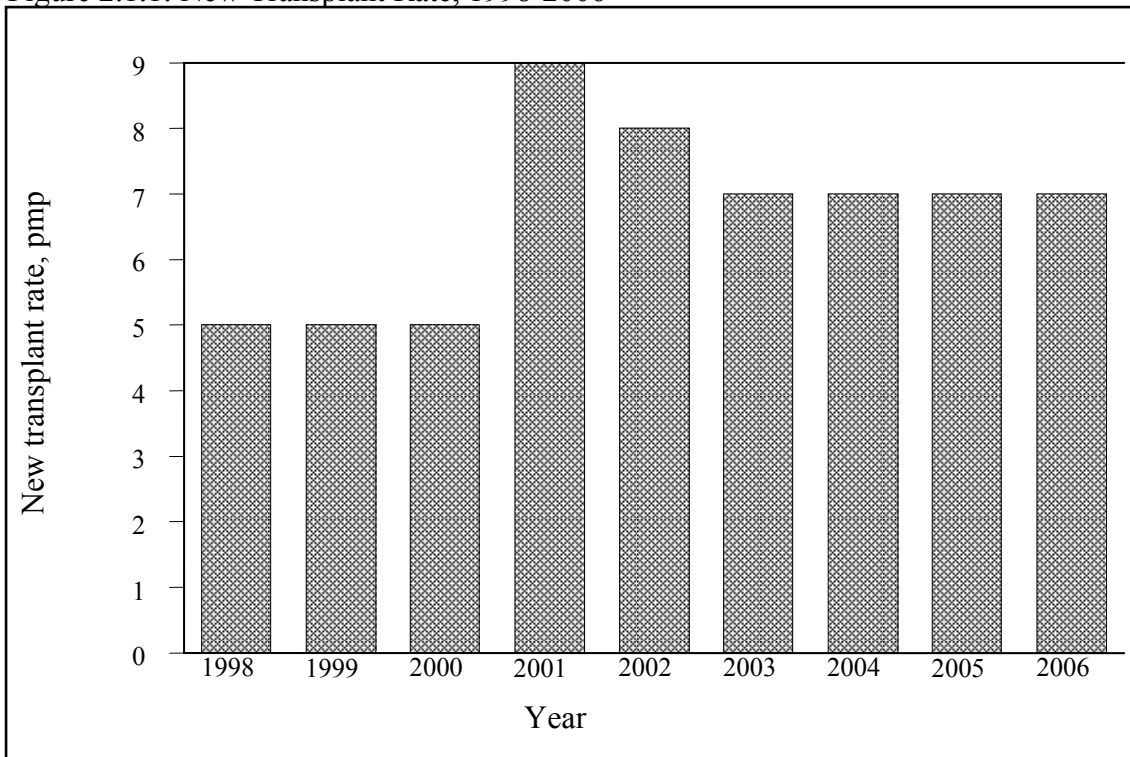


Table 2.1.2: Types of Cornea Transplant, 1998-2006

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=174)		TOTAL (N=1506)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Penetrating Keratoplasty	114	96	116	95	120	95	207	94	196	97	156	95	165	90	173	90	150	86	1397	93
Lamellar Keratoplasty	1	1	5	4	5	4	14	6	5	2	8	5	10	5	13	7	16	9	77	5
Patch Graft for Corneal	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	2	5	3	10	1
Patch Graft for Sclera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	2	0
Cornea Scleral Keratoplasty	0	0	1	1	0	0	0	0	0	0	1	0	7	4	2	1	2	1	13	1
No data	4	3	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	7	0

## 2.2 RECIPIENTS' CHARACTERISTICS

Recipients were predominantly male each year and this ranged from 60% to 69% (Table 2.2.1).

Ethnic Chinese (38%) were the predominant race undergoing cornea transplant surgery followed by Malays (32%) and Indians (23%) (Table 2.2.2).

The mean age was  $45 \pm 21$  years with a range from as young as 2 months of age to as old as 96 years (Table 2.2.3).

The commonest primary indication for surgery was keratoconus (17%) followed by cornea scar (15%), pseudophakic bullous keratopathy (12%) and other (non-pseudophakic) bullous keratopathy (12%) (Table 2.2.4).

There may be one or more indications for cornea transplant surgery. The most frequent indication was optical (Table 2.2.5).

Table 2.2.1: Distribution of Patients by Gender, 1998-2006

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=174)		TOTAL (N=1505)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	78	66	80	66	81	64	142	64	122	60	114	69	112	61	115	60	116	67	960	64
Female	41	34	42	34	45	36	79	36	81	40	51	31	72	39	77	40	58	33	546	36

Table 2.2.2: Distribution of Patients by Ethnic Group, 1998-2006

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=174)		TOTAL (N=1506)		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Ethnic group																					
Malay	28	24	34	28	41	33	70	32	74	36	52	32	66	36	62	32	61	35	488	32	
Chinese	47	39	46	38	50	40	92	42	83	41	67	41	58	32	73	38	57	33	573	38	
Indian	36	30	35	29	28	22	49	22	35	17	34	20	43	23	41	21	40	23	341	23	
Bumiputra Sabah	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	3	2	5	0	
Bumiputra Sarawak	0	0	0	0	0	0	1	0	0	0	0	0	4	2	5	3	4	2	14	1	
Others*	8	7	7	5	6	5	5	2	9	5	11	7	10	5	10	5	9	5	75	5	
No data	0	0	0	0	1	0	4	2	2	1	1	0	2	1	0	0	0	0	10	1	

\*Others: Non Malaysian

Table 2.2.3: Distribution of Patients by Age, 1998-2006

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=174)		TOTAL (N=1506)		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Age group (years)																					
0-9	4	3	5	4	6	5	8	4	9	4	6	4	6	3	8	4	7	4	59	4	
10-19	13	11	17	14	9	7	29	13	16	8	21	13	15	8	14	7	22	13	156	10	
20-39	28	24	34	28	34	27	49	22	53	26	36	22	55	30	59	31	52	30	400	27	
40-59	38	32	32	26	40	32	61	28	57	28	51	31	52	28	45	23	42	24	418	28	
≥60	36	30	34	28	37	29	74	33	68	33	51	31	56	30	66	34	51	29	473	31	
Mean	45		43		44		45		46		45		45		46		44		45		
SD	21		22		20		21		21		21		21		21		22		21		
Median	45		43		45		50		46		46		44		49		43		45		
Minimum	4 months		5		2 months		5 months		1		5 months		2 months		2 months		2 months		2 months		
Maximum	82		92		86		85		86		84		86		84		96		96		

Age=date transplant-date birth; age if provided



Table 2.2.4: Primary Diagnosis, 1998-2006

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=174)		TOTAL (N=1506)		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Primary Diagnosis																					
Keratoconus	24	20	24	20	15	12	38	17	32	16	18	11	34	18	34	18	33	19	252	17	
Corneal scar	33	28	25	20	21	17	34	15	28	14	21	13	26	14	20	10	18	10	226	15	
Microbial keratitis	11	9	11	9	19	15	30	14	31	15	21	13	18	10	13	7	11	6	165	11	
Microbial keratitis+Cornea perforation	1	1	6	5	1	1	6	3	4	2	4	2	17	9	20	10	7	4	66	4	
Corneal perforation (non microbial)	6	5	7	6	8	6	12	5	12	6	27	16	13	7	18	9	20	11	123	8	
Pseudophakic Bullous keratopathy	10	8	16	13	17	13	23	10	15	7	19	12	19	10	35	18	30	17	184	12	
Other (non pseudophakic) bullous keratopathy	14	12	4	3	19	15	37	17	47	23	25	15	16	9	14	7	10	6	186	12	
Failed previous graft	14	12	12	10	13	10	17	8	15	7	14	8	12	7	14	7	9	5	120	8	
Corneal dystrophy	5	4	6	5	5	4	12	5	9	4	7	4	8	4	6	3	10	6	68	5	
Congenital opacity	1	1	1	1	1	1	1	0	0	0	1	1	8	4	4	2	1	1	18	1	
Others	3	3	8	7	7	6	15	7	14	7	10	6	34	18	34	18	35	20	160	11	
No data	0	0	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	4	0	

\*1377 patients have 1 primary diagnosis, 119 have 2 primary diagnoses, 5 patients had 3 diagnoses, and 1 patient had 4 diagnoses

Table 2.2.5: Indications for Cornea Transplant, 2004-2006

Indication for transplant	2004 (N = 184)		2005 (N=192)		2006 (N=174)		Total (N =550)	
	No.	%	No.	%	No.	%	No.	%
Optical	120	65	135	70	122	70	377	69
Tectonic	26	14	23	11	19	11	68	12
Therapeutic	27	14	19	10	17	9	63	11
Tectonic + Therapeutic	9	5	9	5	4	2	22	4
Optical + Tectonic	1	1	1	1	1	1	3	1
Optical + Tectonic + Therapeutic	0	0	1	1	0	0	1	0
Optical + Therapeutic	0	0	0	0	5	3	5	1
Optical + Others	0	0	0	0	1	1	1	0
Others	1	1	4	2	4	2	9	2
No data	0	0	0	0	1	1	1	0

## 2.3 TRANSPLANT DATA, 2004-2006

### 2.3.1 Stock and Flow

There was an increase in the number of cornea transplant notification - complete data sets returned from 75% in 2004 to 100% in 2005 and 2006 (Table 2.3.1.1). Data in this section covers notification data from surgeons who sent a complete data set.

Table 2.3.1.1: Number of Cornea Transplants with Complete Data Set

	2004		2005		2006		Total	
	No.	%	No.	%	No.	%	No.	%
Total number of cornea transplantations performed	184	100	192	100	174	100	550	100
No. of cornea transplantations with complete data set	138	75	192	100	174	100	504	92

### 2.3.2 Pre-transplant Data

Regrfts were performed in 10% of cases (Table 2.3.2.1). Corneal vascularisation was the most frequently encountered pre-operative ocular co-morbidity, followed by ocular inflammation and glaucoma (raised intraocular pressure).

Sixty-eight percent of cases were legally blind (vision 3/60 or worse) prior to cornea transplantation (Table 2.3.2.3).

Table 2.3.2.1: No of Previous Grafts in Grafted Eye, 2004-2006

Graft Number	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
0	123	89	171	89	158	91	452	90
1	11	8	15	8	15	8	41	8
2	3	2	2	1	1	1	6	1
3	0	0	4	2	0	0	4	1
4	1	1	0	0	0	0	1	0

Table 2.3.2.2: Ocular Co-morbidity, 2004-2006

	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
<b>Ocular co-morbidity</b>								
Any ocular co-morbidity (a to d below)	88	64	103	54	78	45	269	53
a) Superficial cornea vascularisation	44	57	48	61	41	72	133	62
b) Deep cornea vascularisation	42	55	39	49	22	39	103	48
c) History of glaucoma	29	33	36	35	33	42	98	36
d) Current ocular inflammation	41	47	50	49	40	51	131	49

\*Patient might have multiple ocular co-morbidities

Table 2.3.2.3: Pre-operative Vision, 2004-2006

Unaided VA	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
6/6	3	2	0	0	1	1	4	1
6/9	1	1	1	1	1	1	3	1
6/12	0	0	2	1	3	2	5	1
6/18	0	0	1	1	0	0	1	0
6/24	3	2	5	3	4	2	12	2
6/36	4	3	6	3	5	3	15	3
6/60	7	5	16	8	17	10	40	8
5/60	1	1	0	0	0	0	1	0
4/60	3	2	1	1	2	1	6	1
3/60	2	1	1	1	2	1	5	1
2/60	1	1	2	1	3	2	6	1
1/60	4	3	9	5	7	4	20	4
CF	47	34	47	24	44	25	138	27
HM	47	34	46	24	37	21	130	26
PL	13	9	15	8	11	6	39	8
NPL	2	1	1	1	0	0	3	1
Others	0	0	1	1	0	0	1	0
No data	0	0	38	20	37	21	75	15

### 2.3.3 Donor Details

Eye Banks in the United States of America (USA) were the most frequent source of the corneal tissues (Table 2.3.3.1). The majority of donors were elderly patients with a median age of 58 years (Table 2.3.3.2). Optisol GS was the commonest cornea tissue storage medium used at 76% (Table 2.3.3.3). The major causes of death of the donors were related to the cardiac or circulatory system (30%) followed by malignancy (15%) (Table 2.3.3.4).

Table 2.3.3.1: Source of Donor Corneal Tissue, 2004-2006

Source of donor	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Local	20	14	19	10	35	20	74	15
USA	95	69	133	69	96	55	324	64
Sri Lanka	22	16	38	20	41	24	101	20
Others	0	0	0	0	2*	1	2	0
No data	1	1	2	1	0	0	3	1
Ethnic group, if local:								
• Malay	0	0	4	21	1	3	5	7
• Chinese	14	70	8	42	12	34	34	46
• Indian	5	25	7	37	22	63	34	46
• Others	0	0	0	0	0	0	0	0
• No data	1	5	0	0	0	0	1	1

\*Others: Taiwanese Chinese

Figure 2.3.3.1: Source of Donor Corneal Tissue, 2004-2006

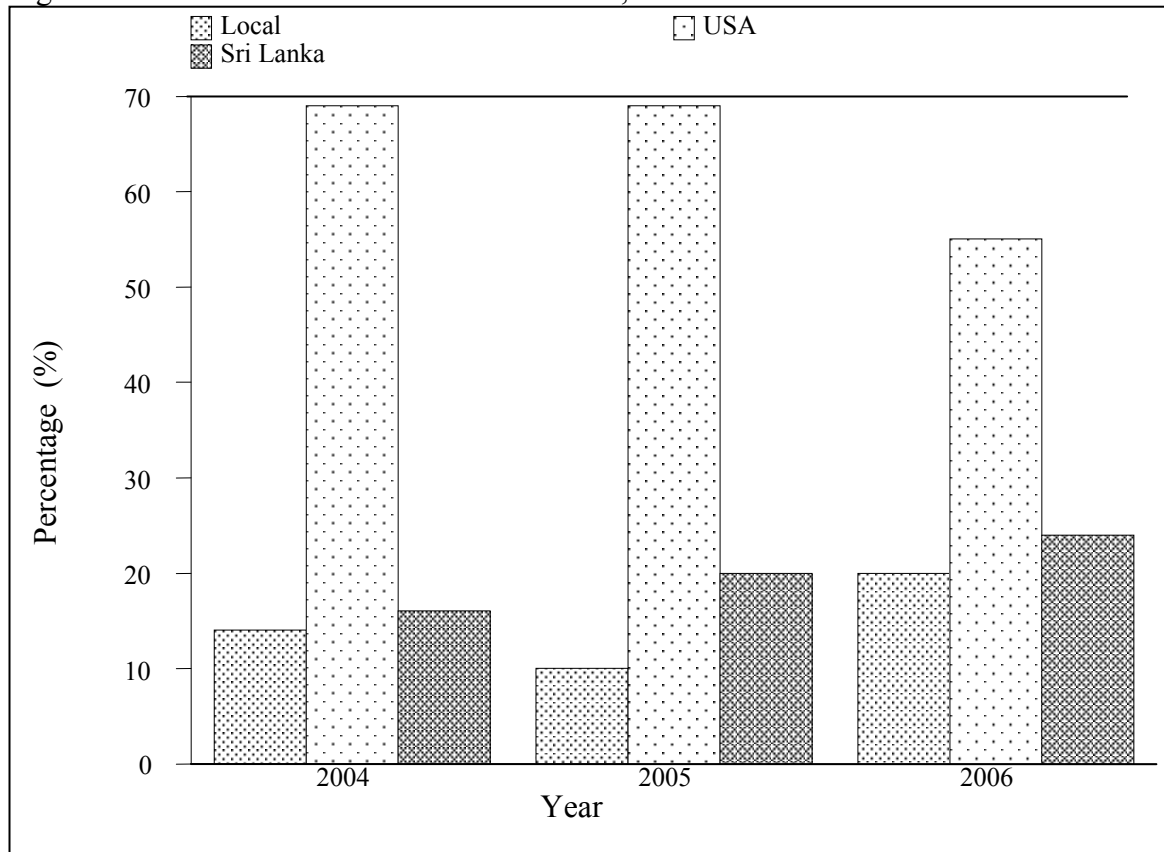


Table 2.3.3.2: Distribution of Donors by Age Group, 2004-2006

Age, years	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
0-9	2	1	3	2	2	1	7	1
10-19	6	4	4	2	9	5	19	4
20-39	11	8	7	4	11	6	29	6
40-59	52	38	89	46	80	46	221	44
≥60	67	49	89	46	72	42	228	45
Mean	56		58		55		57	
SD	15		14		16		15	
Median	59		58		56		58	
Minimum	8		3		6		3	
Maximum	78		79		78		79	

Table 2.3.3.3: Preservation Media, 2004-2006

Preservation media	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Optisol GS	110	80	147	77	126	72	383	76
MK Medium	22	16	37	19	40	23	99	20
Moist Chamber	4	3	3	2	7	4	14	3
Others	0	0	1*	0	0	0	1	0
No data	2	1	4	2	1	1	7	1

\*Others: Eusol-C

Figure 2.3.3.3: Preservation Media, 2004-2006

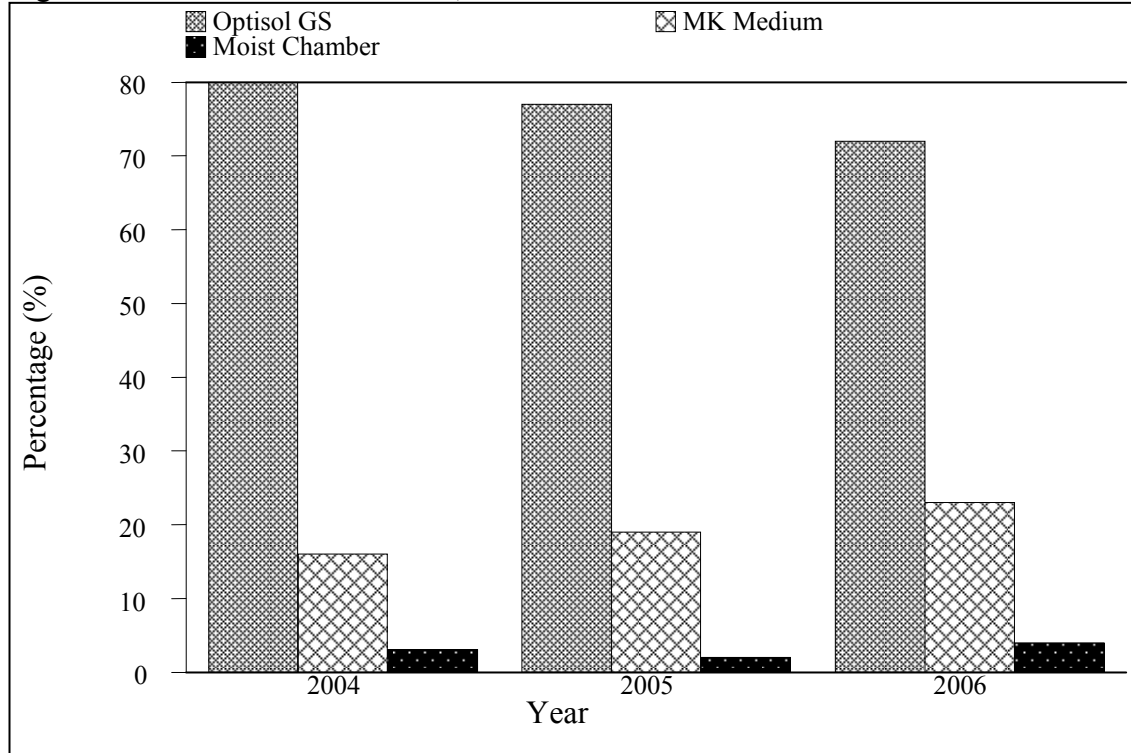


Table 2.3.3.4: Cause of Death in Cornea Donors, 2004-2006

Cause of death	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Cardiac / Circulatory System	47	35	49	26	58	33	154	31
Cerebrovascular System	17	12	25	13	11	6	53	10
Malignancy	19	14	31	16	24	14	74	15
Trauma / Accident	20	14	13	7	19	11	52	10
Respiratory System	15	11	8	4	8	5	31	6
Others	17	12	21	11	26	15	64	13
No data	3	2	45	23	28	16	76	15



### 2.3.4 Transplant Practices

Penetrating Keratoplasty (PK) was the commonest type of surgery performed (88%) (Table 2.3.4.1). Cornea transplantation was performed in combination with other surgical procedures in 20% of cases. Cataract extraction, with or without intraocular lens implantation (IOL), was the commonest combined procedure (Table 2.3.4.2).

The recipient graft size ranged from 2mm to 10mm, with the median recipient cornea graft size being 7.5mm (Table 2.3.4.3). The majority of cases had the donor tissue oversized by 0.5mm (Table 2.3.4.4). The commonest suture technique was interrupted sutures (Table 2.3.4.5).

Table 2.3.4.1: Distribution of Patients by Type of Surgery, 2004-2006

Type of surgery	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Penetrating Keratoplasty	120	88	173	90	150	86	443	88
Lamellar Keratoplasty	10	7	13	7	16	9	39	8
Patch graft for cornea	2	1	3	2	5	3	10	2
Patch graft for sclera	0	0	1	0	1	1	2	0
Cornea Scleral Lamellar Keratoplasty	6	4	2	1	2	1	10	2

Table 2.3.4.2: Type of Combined Surgery, 2004-2006

Combined surgery	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
No. of patients with combined surgery	31	22	27	14	42	24	100	20
(a) Glaucoma surgery	2	6	3	11	2	5	7	7
(b) Cataract Extraction	16	52	13	48	22	52	51	51
(c) IOL	14	45	10	37	24	57	48	48
(d) Cataract extraction and IOL	10	32	8	30	16	38	34	34
(e) Retinal Surgery ± Internal Tamponade	1	3	1	4	2	5	4	4
(f) Anterior vitrectomy	9	29	3	11	5	12	17	17
(g) Others	5	16	8	30	8	19	21	21

\*Patients may have more than one combined surgery

Table 2.3.4.3: Recipient Cornea Trephine Size, 2004-2006

Graft size, mm	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
2	1	1	1	1	2	1	4	1
3	0	0	1	1	2	1	3	1
4	1	1	2	1	1	1	4	1
5	0	0	0	0	0	0	0	0
5.5	1	1	0	0	0	0	1	0
6	3	2	0	0	5	3	8	2
6.25	0	0	1	1	0	0	1	0
6.50	2	1	5	2	4	2	11	2
6.75	1	1	3	2	2	1	6	1
7	25	18	36	18	24	14	85	17
7.25	10	7	10	5	14	8	34	7
7.50	36	26	18	9	24	14	78	15
7.75	10	7	11	5	6	3	27	5
8	19	14	7	4	13	7	39	8
8.25	4	3	4	2	5	3	13	3
8.50	6	4	6	3	2	1	14	3
8.75	0	0	1	1	0	0	1	0
9	8	6	3	2	1	1	12	2
9.25	0	0	0	0	0	0	0	0
9.50	0	0	2	1	0	0	2	0
9.75	0	0	0	0	0	0	0	0
10	1	1	0	0	0	0	1	0
No data	10	7	81	42	69	40	160	32
Mean	7.5		7.3		7.2		7.3	
SD	0.9		1		1.1		1	
Median	7.5		7.3		7.3		7.5	
Minimum	2		2		2		2	
Maximum	10		9.5		9		10	

Table 2.3.4.4: Difference in Trephined Sizes of Recipient and Donor Corneas, 2004-2006

Difference in Graft size, mm	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Same size	9	7	8	4	8	4	25	5
0.25	29	21	19	10	29	17	77	16
0.5	87	62	84	44	65	37	236	47
0.75	1	1	0	0	1	1	2	0
1	1	1	0	0	1	1	2	0
2	1	1	0	0	0	0	1	0
Not available	10	7	81	42	70	40	161	32

Table 2.3.4.5: Suture Technique, 2004-2006

Suture Technique	2004 (N=138)		2005 (N=192)		2006 (N=174)		Total (N=504)	
	No.	%	No.	%	No.	%	No.	%
Interrupted only	132	96	139	73	122	70	393	78
Continuous only	0	0	0	0	5	3	5	1
Combined	6	4	18	9	17	10	41	8
No data	0	0	35	18	30	17	65	13